4.2.7 Severed and Otherwise Affected Farm Operations

A severed farm operation is an operation in which the farmland is severed either laterally or diagonally by the right of way, thus dividing a contiguous parcel into two or more individual plots, as shown on Figure 4-9. An otherwise affected farm operation is farmland affected by the right of way, but not divided into separate farm parcels. Alternate 1 has the highest number (114) of severed parcels, while Alternate 2 (the Preferred Alternate) has the lowest number (98). Alternates 4, 5, 8, 10, and 12 cluster around the average of 106 severed parcels. The number of severed farm units and affected farm units are shown in Table 4-34.

A farm operation is defined as one or more parcels of land farmed as a single operation. It is farmed under one management although it may be under multiple ownership. The limits of farm properties and names of owner/operators were obtained from tract maps provided by the Jo Daviess County and Stephenson County Consolidated Farm Services Agencies as of February 1995. Alternate 11 has the highest number (85) of affected parcels, while Alternate 2 (the Preferred Alternate) has the fewest number (67). Alternates 8, 9, and 10 cluster around the average of 76 affected parcels. The number of affected farm units is shown in Table 4-34.

4.2.8 Severance Management Zones

Severance management zones are those areas of the farm that, after being diagonally severed by a build alternative, are adversely affected by the proposed right of way. These zones are triangular in shape and cause operational management problems for the farmer.

In these severance management zones, point rows are created when rows intersect the end or turn row, as shown on Figure 4-9. Rows coming together in this skewed fashion are difficult to farm efficiently. Tractor use during fertilizer and herbicide application, cultivation, and harvest may cause production losses due to plant loss. The newly created triangular shaped fields force the operator to turn his tractor and implements in an inefficient manner that damages or removes plants and may cause over application of farm chemicals. When the operational disruption caused by diagonal severance is substantial, or when the slope of the land allows planting in only one direction, a farmer may be forced to abandon row crop farming in that field. This may conflict with his normal farming operations and have an adverse economic effect. If livestock production is part of a severed farm's operation, additional animal fencing may be required. The affect is more serious with sharper skews and is particularly pronounced in areas of farmland where crops are normally tilled in square or rectangular fields with no landscape obstructions such as woods, ponds, and creeks.

The Alternate with the largest amount of severance management zones is Alternate 4, with 74 hectares (184 acres). The Alternate with the least amount of severance management zones is Alternate 2 (the preferred Alternate), with 57 hectares (142 acres). The acreage of severance management zones is shown in Table 4-34.

4.2.9 Landlocked Parcels

A landlocked parcel is defined as that portion of the land isolated by the right of way, thereby rendering it inaccessible by public road, existing easement, or proposed access roads. The preliminary design attempted to provide access to all properties, thus limiting the occurrence of landlocked parcels, as shown on Figure 4-9. However, some instances of landlocked parcels are unavoidable. The maximum number of landlocked parcels, 42, is created by Alternate 12, resulting in the highest area at 429 hectares (1,055 acres) of landlocked parcels. Alternates 5

Figure 4-9 Affected Farm Operations

and 7 create the minimum number of landlocked parcels, 29. Alternate 8 produces the least number of hectares (acres) at 167 (412) of landlocked parcels. The Preferred Alternate, Alternate 2, creates 34 landlocked parcels at 222 hectares (548 acres). The data for landlocked parcels is shown in Table 4-34. The Department will offer to buy any identified uneconomic remnants, including landlocked parcels, from property owners. Uneconomic remnants are remainder properties that have little value or are of little use to the property owner.

4.2.10 Adverse Travel

Adverse travel is a measure of the additional miles traveled by a farmer to reach a severed or otherwise affected parcel of land created by the proposed highway construction, as shown in Table 4-34. Landlocked parcels are not included in the measurement of adverse miles since they will be inaccessible to current farm operators.

Adverse travel imposes costs on the owner and operator in terms of time lost, machine wear, and energy expense. Because the margin of commodity prices over production costs is small, added cost due to adverse travel can be a significant factor. If livestock production is part of a severed farm's operation, additional animal fencing may be required. In addition, increased safety risks occur when farmers are required to take slow machinery onto well-traveled roads.

Road closures may occur under some Alternates for this project. Road closures could prevent a farmer from getting to an operation by the customary route. To accurately determine the amount of adverse travel resulting from road closures, the location of the farm operator's home and his customary access route must be known. A road closure hearing will be held if an Alternate is chosen which requires road closures, and adverse travel effects will be further defined then.

The formula "AT=CD-AB" defines adverse travel (AT) and is calculated by deciding the shortest route necessary to travel from the field edge of one severed parcel (Point C) via a public road or existing pavement to the field edge of a second severed parcel (Point D), as shown on Figure 4-9. This distance is then doubled to account for one round trip. Existing mileage, from Point A to Point B (prehighway), is also calculated for a round trip and subtracted from CD. The resulting number is the measure of adverse travel miles if positive and non-adverse travel miles if negative.

Adverse travel was determined by using the shortest existing route between Point A and Point B along public roads and existing easements. Sometimes, public roadways may be too narrow to allow farm machinery to pass. In other instances, bridges on public roads may not be of sufficient strength or width to allow heavy farm machinery to cross. These potential impediments to travel were not considered in the initial assessment of adverse travel effects. The total miles of adverse travel may be affected by placement of freeway access roads. Placement of access roads will be established as part of engineering design activities.

The maximum amount of adverse travel (based on one round trip) will result from construction of Alternate 12, with a total of 227 kilometers (141 miles) being added to normal travel routes. Alternate 3 will create 155 kilometers (96 miles) of adverse travel miles, the minimum number of any alternate. Alternate 2, the preferred Alternate, will create 177 kilometers (110 miles) of adverse travel – the second lowest. It is important to note that the total number of adverse miles traveled by the owner/operator may change significantly due to engineering design of the highway and construction of access ramps and median crossovers. However, the right-of-way required for access and frontage roads was considered and is a part of the total right-of-way required for the improvement.

4.2.11 Farm Displacements

The number of farm buildings that require demolition or removal due to highway construction, including farm residences, barns, sheds, pens, bins, silos, windmills, or other structures associated with farm operations, was determined from field reconnaissance of the proposed alternates and review of recent aerial photographs.

The construction of Alternate 11 will displace the maximum number of farm residences, 45. Alternate 2 (the preferred alternate) will displace the minimum number of farm residences, 25. The maximum number of other farm structures displaced will occur through construction of Alternate 11 (125). Alternate 2 displaces the least amount of other farm structures at 85. Table 4-34 lists the displacements for all alternates.

4.2.12 Agricultural Income Loss

To estimate the loss of agricultural income from right-of-way takes in each Alternate, the total number of farm acres per county was divided into the total agricultural receipts (including livestock) from each county. The resulting number gives an approximate annual income loss for an acre of land in each county. The figures generated for Jo Daviess and Stephenson Counties were multiplied by the approximate agricultural acres taken by the right of way in each county to determine income loss resulting from construction of each Alternate.

According to the *Illinois Agricultural Statistics Annual Summary — 2001*, the total 2000 receipts for farm marketing in Jo Daviess County was $69,197,000. Total 1997 farm acres in Jo Daviess County were 111,592 hectares (275,750 acres), according to the *1997 Census of Agriculture*. In Jo Daviess County, the approximate annual cash receipt per hectare (acre) of land is, therefore, $620 ($251). The total 2000 cash receipts for farm marketing in Stephenson County were $116,944,000. According to the *1997 Census of Agriculture,* the total 1997 farm acres in Stephenson County were 124,876 hectares (308,574 acres). Therefore, the approximate annual cash receipt per hectare (acre) is in Stephenson County is $936 ($379).

Alternate 5 has the largest agricultural income loss, as shown in Table 4-34, at $771,000 per year due to the construction of this alternate. There are 886 hectares (2,192 acres) required from Jo Daviess County and 236 hectares (581 acres) required from Stephenson County for Alternate 5. Alternate 11 and Alternate 12 have the smallest agricultural income loss at $686,000 per year. There are 780/781 hectares (1,932/1,933 acres) required from Jo Daviess County and 216 hectares (530/531 acres) required from Stephenson County for Alternates 11 and 12, respectively. Alternate 2, the Preferred Alternate, has an agricultural income loss $709,000 per year. There are 788 hectares (1949 acres) from Jo Daviess County and 236 hectares (581 acres) from Stephenson County. See Table 4-34 for the agricultural income loss by Alternate.

4.2.13 Drainage

4.2.13.1 Surface Drainage

The character of the land along the study corridor between the intersection of Illinois Route 84 and U.S. Route 20, northwest of Galena, varies from nearly vertical valleys or canyon walls of 15 to 30 meters (50 to 100 feet) in the unglaciated area around Galena to gently rolling topography near Freeport. In most areas of Jo Daviess County and the steeper areas of Stephenson County, farmers have implemented erosion control and soil conservation practices by constructing terraces and by contour plowing. Many farmers have constructed grass waterways and installed field tile systems to drain the flatter and depressional areas where natural drainage does not drain their fields.

Existing drainage patterns and ditch flow line elevations have been taken into consideration when selecting proposed vertical alignment. Drainage structures will be designed so that existing draining patterns will be maintained with minimal effects.

4.2.13.2 Subsurface Drainage

Subsurface farm tiles are located throughout the project, but generally in the gently rolling area east of Stockton to the eastern termini northwest of Freeport. The Department will schedule meetings with farmers along the chosen Alternate to determine tile locations. Mapping of field tile placement was not a common practice until recently. Identified farm field tiles that intersect with U.S. Route 20 (FAP 301) will either be relocated, outletted into side ditches along U.S. Route 20, or replaced with higher strength pipe beneath U.S. Route 20. During construction, exploratory trenching will be done (where needed) along the highway alignment to locate field tiles identified during preparation of construction plans and to locate other tiles not identified before construction.

No adverse effects to the existing subsurface drainage system are anticipated due to the construction of U.S. Route 20.

4.2.14 Erosion and Sediment Control

The affect upon the soils in terms of erosion and sedimentation has the potential to be extreme due to the topography and the erosive nature of many of the soils found within the project area.

A site analysis will be performed and areas sensitive to erosion will be identified. Then specific erosion control measures will be identified. These specific erosion control measures will become a part of an erosion control plan. This erosion control plan will be included with the final roadway design plans for the selected alternate, which will cover all right-of-way; including streams, bridges, borrow sites and roadways, as well as protection to surrounding areas. This project will require a National Pollutant Discharge Elimination System (NPDES) permit. The NPDES permit will include a stormwater pollution prevention plan.

4.3 Cultural Resources

The cultural resources surveys conducted along the project corridor recorded numerous prehistoric and historic sites. Of over 300 historic period standing structures recorded, only five which are potentially eligible for listing on the National Register of Historic Places may be adversely impacted by the proposed project construction. However, none of these structures–three houses and two barns–will be directly impacted. Upon selection of a Preferred Alternate and once detailed construction plans are available, the Illinois SHPO will review the design plans, to determine whether the project will have any effects on these historic properties. An analysis of these more detailed construction plans will be conducted prior to the production of a Final Environmental Impact Statement, in order to assess any potential impacts to these historic properties which may be subject to Section 4(f) of the Transportation Act of 1966. If there are impacts to one or more of these properties for which there are no feasible or prudent alternates, Section 4(f) statements will be submitted to the FHWA for review and concurrence.

All mounds and cemeteries will be avoided by the proposed project. To date, no archaeological sites historically associated with a federally-recognized Native American tribe have been found in the project area. Once a preferred alignment is selected, a total archaeological survey will be completed. The results of this survey will be submitted to the Illinois SHPO and to the Native American tribes enumerated in Section 2.5 of this document for review and comment. Should archaeological sites be found in the preferred alignment which have the potential to meet the criteria for eligibility for the National Register, a program of subsurface evaluation will be implemented. The results of these investigations will then be evaluated for a Determination of Eligibility (DOE) for the National Register of Historic Places. A formal DOE will be submitted to the Illinois SHPO for concurrence. Should any of these archaeological sites be determined eligible, a data recovery plan will be formulated and submitted to the Illinois SHPO and the Federal Highway Administration under the Statewide Programmatic Agreement for Prehistoric Sites, ratified on September 19, 2002. A copy of the data recovery plan will then be filed with the Advisory Council on Historic Preservation.

All of the prehistoric archaeological sites found to date which are within the project corridor are the remains of former habitation sites. All of the historic period archaeological sites within the alternate alignments are the remains of former habitation sites or industrial sites (mines or pottery works). The potential significance of these archaeological sites rests upon the scientific data which they may contain. None of these sites requires preservation in place, none are cemeteries, and none are subject to Section 4(f) of the Transportation Act of 1966.

Appendix E provides the Section 106 coordination and correspondence.

4.4 Air Quality

4.4.1 Project Impacts

Along with the No-Action Alternative, the Freeway and Expressway Alternates were analyzed for potential carbon monoxide impacts. Modeling was conducted at three separate locations to cover the Freeway and Expressway Alternates. One location was at the village of Lena (see Appendix I) for Alternates 1 through 12. This area was selected since it has a unique arrangement of the existing roadway, the proposed Expressway Alternate, and the proposed Freeway Alternates all being located in close proximity to one another. This close proximity allowed for a single area to be modeled with impacts from all three scenarios thereby allowing a comparative analysis of impact between the three Alternates.

For Freeway Alternates 1 through 10, two separate areas were selected for modeling (see Appendix I); one for Alternates 1 and 2, and one for Alternates 3 through 10. Due to the ruralness of the areas in which the freeway alternates are proposed to pass, only the proposed Alternate was modeled. The ambient 8-hour background concentration of 2.0 parts per million was assumed to exist for the No-Action Alternative.

4.4.1.1 Carbon Monoxide (CO) Impacts/Village of Lena

The results of the CO modeling for the village of Lena are presented in Table 4-35. As the table suggests, in all the build scenarios the CO concentrations are predicted to decrease from the No-Action Alternate. There is no significant difference in the predicted CO concentrations between the expressway and freeway alternates. Both Alternates are predicted to have a slightly beneficial effect on air quality, and are below the eight-hour NAAQS for CO of 9.0 ppm.

TABLE 4-35
HIGHEST PREDICTED CO CONCENTRATIONS (PPM)
NO-ACTION, FREEWAY AND EXPRESSWAY ALIGNMENTS

Alternate	2002	2010	2020	Alternate	2002	2010	2020
	8-hour Concentration **Town of Lena** (Receptors)				8-hour Concentration **Freeway Alignments** (Receptors)		
No-Action	2.9 (R11)	3.1 (R11)	3.3 (R11)	No-Action	Assumed to be ambient background of 2.0 ppm*		
Freeway (Alternates 1 through 10)		2.8 (R8)	3.0 (R8)	Freeway (Alternates 1 and 2)		2.5 (R19)	2.6 (R19)
Expressway (Alternates 11 and 12)		2.8 (R11)	3.1 (R11)	Freeway (Alternates 3 through 10)		2.4 (R1,R6, R12,R13,R17,R18,R21)	2.3 (R12, R18)

8-hour NAAQS for CO = 9.0 ppm
* IDOT Air Quality Manual

2002: Existing Year

2010: Time of Completion (TOC) Year

2020: TOC+10 and Design Year

4.4.1.2 Carbon Monoxide (CO) Impacts/Freeway Alternates

The results of the CO modeling for the Freeway Alternates are also presented in Table 4-35. As can be seen, the various freeway alternates show an increase in CO concentration over the No-Action Alternate. There is a slight difference in the predicted CO concentrations between Freeway Alternates 3 through 10 and 1 and 2, where Freeway Alternates 1 and 2 result in CO concentrations 0.3 ppm higher than Alternates 3 through 10. However, all of the Freeway Alternates are still well below the NAAQS for CO of 9.0 ppm.

4.4.1.3 Construction Impacts: Particulate Matter

Demolition/construction related activities can result in short term impacts to ambient air quality. These impacts are typically related to fugitive dust emissions in and around the site as a result of demolition/construction operations. Other potential air quality impacts from these activities are usually insignificant when equipment is well maintained and operated in well-ventilated areas. The potential for impacts will be short-term, occurring only while demolition or construction work is in progress and local conditions are appropriate.

Fugitive dust emissions typically occur during building demolition, ground clearing, site preparation, grading, stockpiling of materials, on-site movement of equipment, and material transportation. They are greatest during dry periods, periods of intense construction activity and during high wind conditions.

The Department has established a special provision for the control of particulate matter impacts in *Standard Specifications for Road and Bridge Construction, Section 107.36, Dust Control*. Under this provision, the dust and air-borne dirt generated by construction activities will be controlled under dust control procedures or a specific plan. The construction contractor and the Department shall meet to review the nature and extent of dust generating activities and cooperatively develop specific types of control techniques to that specific situation. Sample techniques include such measures as minimizing track out of soil onto nearby publicly traveled roads, reducing vehicle speed on unpaved surfaces, covering haul vehicles, and applying chemical dust suppressants or water to exposed surfaces, particularly to surfaces on which construction vehicles travel. With the application of these mitigation techniques to limit particulate emissions during demolition and construction activities, the proposed project will not have significant short-term particulate matter impacts.

4.4.2 Project Mitigation

Since the CO modeling indicates that there will be no significant CO impacts, no mitigation measures are warranted to control vehicle emissions.

4.4.3 Project Conformity

No portion of this project is within a designated nonattainment area for any of the air pollutants for which the USEPA has established standards. Accordingly, a conformity determination under 40 CFR Part 93 (“Criteria and Procedures for Determining Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Funded or Approved Under Title 23 USC or the Federal Transit Act”) is not required.

4.5 Noise

4.5.1 Introduction

Impacts were analyzed and evaluated against the Noise Abatement Criteria (NAC) described in Section 2.0. The FHWA criterion for category B land use receptors dictates that a noise impact exists when noise levels approach (within one dBA) or exceed 67 dBA. Also, the Department’s policy considers an impact to occur when noise levels increase by more than 14 dBA over existing noise levels due to a project's traffic noise. Mitigation measures were considered and evaluated, per FHWA and Department policies, when an impact was determined to have occurred. As part of the mitigation analysis, noise barriers were analyzed for receptors along the Alternate alignments.

4.5.2 Impacts

In general, the traffic noise modeling is composed of a large number of variables that describe various types of vehicles operating at different speeds through a continuously changing highway configuration and surrounding terrain. Due to the complexity of the project and the project area, the following assumptions have been made to simplify the prediction of highway traffic noise:

- All vehicles have been divided into three categories: cars, medium trucks, and heavy trucks. Each of those categories has been assigned a Reference Energy Mean Emission Level (REMEL) based on the data collected from field traffic noise measurements.

- No wind or temperature effects have been considered in the computer modeling. However, wind and temperature can have substantial impact on propagation of sound over distances above 300 feet (i.e., noise levels at receptors located upwind are substantially (20 dBA) lower than noise levels at receptors located downwind).

- Ground cover along the sound propagation path has been assumed to be homogeneous, with a default propagation rate of 4.5 dBA per doubling of distance, thereby simulating an acoustically "soft" surface (i.e., farm land, lawn and pasture, etc.).

- The additional sound reduction due to existing obstructions on the ground (such as rows of houses) has been assigned as a shielding factor for particular road-receptor pairs.

In particular, future noise levels are predicted for the worst-case scenario. Traffic conditions are assumed at LOS E for the No-Action Alternative and LOS B for the Alternates.

The number of sensitive receptors, i.e., single- and multiple-family residences, schools, parks, hospitals, and churches, etc., with noise levels approaching or exceeding the NAC of 67 dBA, or exceeding the Department's substantial increase criteria, for every section of the alternates was counted, and is presented in Table 4-36. Modeled receptor locations for the alternates are presented on the Environmental Inventory Maps in Appendix N, and in Volume 2 of the Noise Technical Study. A detailed discussion of traffic noise modeling results for the No-Action Alternative and Build Alternates follows.

4.5.2.1 No-Action Alternative

Based on the traffic data from the U.S. Route 20 *Traffic Engineering Study,* the U.S. Route 20 mainline experienced LOS C to E along various sections of U.S. Route 20 in the existing year 2000. In the year 2020, the No-Action Alternate would experience a LOS E condition on all sections of U.S. Route 20. In the year 2020, with the Alternates, the traffic condition would be improved substantially, with an LOS B expected during the A.M. and P.M. peak hours along most of the U.S. Route 20.

Since the traffic flow condition (volume, speed) is constrained by the physical conditions of the roadway, the worst-case noise level is also related to the traffic condition (volume, speed) on the roadway. As introduced in Section 2.0 of this report, the noise level Leq would reach a maximum value at the LOS D condition. The noise level Leq attributed to the roadway traffic would decrease in other traffic conditions, i.e. LOS A, B, C, or F. Traffic volumes in conditions of LOS A, B, C or E would be less than the traffic volumes in LOS D. At LOS F, the roadway would experience congestion and would move at a slower speed. In either case, the traffic conditions would result in a lowered noise level value.

Table 4-36 U.S. Route 20 Noise Levels and Impacts along Sections Analyzed

Sections	Modeling Receptor ID	Number of Receptors	Existing Year Leq (dBA)	Year 2020 Leq (dBA)	Increase over Existing (dBA)	Receptor Meets NAC	Receptor with more than 14 dBA Increases
AB (Stations 487 to 1037)	LH513	1	64	67	3	1	0
	LH527	1	64	60	-4	0	0
	LH616	1	49	61	12	0	0
	LH619	1	49	67	18	1	0
	LH650	1	49	60	11	0	0
	LH667	1	49	64	15	0	1
	LH677 (R9)	1	49	64	15	0	1
	LH715	1	49	59	10	0	0
	LH795 (R10)	1	50	64	14	0	0
	LH820	1	50	61	11	0	0
	LH844	1	50	60	10	0	0
	LH847	1	50	58	8	0	0
	LH870	1	50	57	7	0	0
	LH895	1	50	59	9	0	0
	LH920	1	50	58	8	0	0
	LH950	2	50	58	8	0	0
	LH965	1	50	63	13	0	0
	LH1000	1	51	60	9	0	0
	LH1015	1	51	68	17	1	0
	LH1035	2	51	63	12	0	0
	Max	2	64	68	18	1	1
	Min	1	49	57	-4	0	0
	Total	22				3	2
BC (Stations 1037 to 1347)	EX1045	1	49	58	9	0	0
	R160	1	49	55	6	0	0
	R186	1	49	52	3	0	0
	R208	1	49	56	7	0	0
	R216	1	49	56	7	0	0
	R243	1	49	58	9	0	0
	EX1237	1	49	63	14	0	0
	EX1256	1	49	58	9	0	0
	EX1298	1	49	62	13	0	0
	Max	1	49	63	14	0	0
	Min	1	49	52	3	0	0
	Total	9				0	0
BD (Stations 6015 to 6457)	IH6030	1	43	56	13	0	0
	IH6049	1	43	59	16	0	1
	IH6108	1	43	59	16	0	1
	IH6168 (R20)	1	43	64	21	0	1
	IH6249	1	43	61	18	0	1
	IH6268	1	43	58	15	0	1
	IH6296	1	43	63	20	0	1
	IH6325	1	43	60	17	0	1
	IH6361	1	43	56	13	0	0
	IH6372	1	43	59	16	0	1

Source: The Louis Berger Group, Inc., 2002.

Table 4-36 (Cont.) U.S. Route 20 Noise Levels and Impacts along Sections Analyzed

Sections	Modeling Receptor ID	Number of Receptors	Existing Base Year Leq (dBA)	Year 2020 Leq (dBA)	Increase over Existing (dBA)	Receptor Meets NAC	Receptor with more than 14 dBA Increases
	IH6383	1	43	68	25	1	0
	IH6395	1	43	60	17	0	1
	IH6450 (R21)	1	40	63	23	0	1
	IH6455	1	40	67	27	1	0
	Max	1	43	68	27	1	1
	Min	1	40	56	13	0	0
	Total	14				2	10
BF (Stations 1037 to 1692)	LH1050	1	49	60	11	0	0
	LH1185 (R11)	1	51	64	13	0	0
	LH1235 (R12)	1	49	58	9	0	0
	LH1310	1	49	69	20	1	0
	LH1325	1	49	60	11	0	0
	LH1340	1	49	64	15	0	1
	LH1339	1	49	59	10	0	0
	LH1440 (R13)	1	48	61	13	0	0
	LH1595	1	56	60	4	0	0
	LH1620	1	56	70	14	1	0
	LH1638 (R14)	1	56	65	9	0	0
	Max	1	56	70	20	1	1
	Min	1	48	58	4	0	0
	Total	11				2	1
CD (Stations 1347 to 1405)	EX1350	1	43	62	19	0	1
	IH6450 (R21)	1	40	62	22	0	1
	IH6455	1	40	67	27	1	0
	Max	1	43	67	27	1	1
	Min	1	40	62	19	0	0
	Total	3				1	2
CI (Stations 1347 to 1831)	EX1350	1	43	60	17	0	1
	EX1409	1	49	62	13	0	0
	EX1410	1	49	59	10	0	0
	EX1429	1	40	59	19	0	1
	EX1452	1	43	57	14	0	0
	EX1456	1	43	59	16	0	1
	EX1460 (R4)	1	43	63	20	0	1
	EX1475	1	49	59	10	0	0
	EX1485	1	49	60	11	0	0
	EX1494	1	62	57	-5	0	0
	EX1495	1	66	65	-1	0	0
	EX1504	1	56	52	-4	0	0
	EX1505	1	66	61	-5	0	0
	EX1530	1	68	62	-6	0	0
	EX1535	1	57	59	2	0	0
	EX1540	1	49	57	8	0	0

Source: The Louis Berger Group, Inc., 2002.

Table 4-36 (Cont.) U.S. Route 20 Noise Levels and Impacts along Sections Analyzed

Sections	Modeling Receptor ID	Number of Receptors	Existing Base Year Leq (dBA)	Year 2020 Leq (dBA)	Increase over Existing (dBA)	Receptor Meets NAC	Receptor with more than 14 dBA Increases
	EX1555	1	68	64	-5	0	0
	EX1559	1	68	67	-2	1	0
	EX1565	1	68	59	-9	0	0
	EX1567	2	68	57	-11	0	0
	EX1569	1	49	62	13	0	0
	EX1570	4	62	60	-2	0	0
	EX1587	1	63	57	-6	0	0
	EX1590	1	49	60	11	0	0
	EX1600	1	63	63	0	0	0
	EX1614	1	49	60	11	0	0
	EX1619	1	49	58	9	0	0
	EX1630	2	63	62	-1	0	0
	EX1638	24	60	59	-1	0	0
	EX1640	6	63	60	-3	0	0
	EX1641	1	63	68	5	1	0
	EX855	1	57	57	0	0	0
	EX865	1	63	59	-4	0	0
	EX890	1	49	63	14	0	0
	EX915	15	71	57	-14	0	0
	EX995	6	63	66	3	6	0
	EX995A	12	55	57	2	0	0
	EX1005	1	66	68	2	1	0
	EX1040	1	66	68	2	1	0
	EX1055	1	61	69	8	1	0
	EX1070	1	68	65	-3	0	0
	EX1090	1	55	57	2	0	0
	EX1115	1	60	63	3	0	0
	EX1137	1	57	61	4	0	0
	EX1150	1	63	67	4	1	0
	EX1175	1	62	58	-4	0	0
	EX1195	1	62	57	-5	0	0
	EX1216	1	67	57	-10	0	0
	EX1255	1	62	59	-3	0	0
	EX1262	1	57	61	4	0	0
	EX1290	31	57	58	1	0	0
	EX1314 (R5)	1	57	61	4	0	0
	EX1315	1	57	61	4	0	0
	EX1440	1	57	60	3	0	0
	EX1475	1	62	64	2	0	0
	EX1485	1	61	66	5	1	0
	EX1520	1	70	65	-5	0	0
	EX1550	1	68	64	-5	0	0
	EX1575	1	70	68	-3	1	0
	EX1580	1	68	68	0	1	0

Source: The Louis Berger Group, Inc., 2002.

Table 4-36 (Cont.) U.S. Route 20 Noise Levels and Impacts along Sections Analyzed

Sections	Modeling Receptor ID	Number of Receptors	Existing Base Year Leq (dBA)	Year 2020 Leq (dBA)	Increase over Existing (dBA)	Receptor Meets NAC	Receptor with more than 14 dBA Increases
	EX1603	1	68	65	-3	0	0
	EX1620	1	69	70	1	1	0
	EX1634	1	70	67	-3	1	0
	EX1670	1	70	67	-3	1	0
	EX1690	1	74	70	-4	1	0
	EX1705	1	60	66	6	1	0
	EX1707	1	58	60	2	0	0
	EX1801	1	68	68	0	1	0
	EX1818 (R6)	1	57	62	5	0	0
	EX1821	1	63	67	4	1	0
	Max	31	74	70	20	6	1
	Min	1	40	52	-14	0	0
	Total	163				22	4
DE (Stations 6457 to 6571)	IH6473	1	43	67	24	1	0
	IH6501	1	43	63	20	0	1
	IH6502 (R22)	1	43	58	15	0	1
	IH6507	3	43	66	23	3	0
	IH6510	3	43	59	16	0	3
	IH6546	1	43	61	18	0	1
	Max	3	43	67	24	3	3
	Min	1	43	58	15	0	0
	Total	10				4	6
EF North (Stations 8008 to 1691)	IH8085 (R23)	1	46	56	10	0	0
	IH8090	1	63	58	-5	0	0
	IH8105	2	49	67	18	2	0
	IH8125	11	63	56	-7	0	0
	IH8125A	10	60	52	-8	0	0
	IH8168	1	46	64	18	0	1
	IH8195	1	46	58	12	0	0
	IH8215	1	58	58	0	0	0
	IH6828 (R14)	1	56	62	6	0	0
	IH6848	1	56	68	12	1	0
	Max	11	63	68	18	2	1
	Min	1	46	52	-8	0	0
	Total	29				3	1
EF South (Stations 6571 to 1691)	IH6595	1	43	59	16	0	1
	IH6613	1	43	58	15	0	1
	IH6615	1	43	56	13	0	0
	IH6650	1	43	57	14	0	0
	IH6713	3	46	64	18	0	3
	IH6714	7	46	61	15	0	7
	IH6715 (R23)	9	46	59	13	0	0
	IH6716	1	46	61	15	0	1

Source: The Louis Berger Group, Inc., 2002.

Table 4-36 (Cont.) U.S. Route 20 Noise Levels and Impacts along Sections Analyzed

Sections	Modeling Receptor ID	Number of Receptors	Existing Base Year Leq (dBA)	Year 2020 Leq (dBA)	Increase over Existing (dBA)	Receptor Meets NAC	Receptor with more than 14 dBA Increases
	IH6734	1	46	59	13	0	0
	IH6758	1	46	65	19	0	1
	IH6763	1	46	59	13	0	0
	IH6782	1	46	58	12	0	0
	IH6788	1	46	70	24	1	0
	IH6828 (R14)	1	56	62	6	0	0
	IH6848	1	56	68	12	1	0
	Max	9	56	70	24	1	7
	Min	1	43	56	6	0	0
	Total	31				2	14
FG (Stations 1692 to 1856)	LH1705	1	49	70	21	1	0
	LH1730	1	49	57	8	0	0
	LH1760	1	60	56	-4	0	0
	LH1790	1	49	61	12	0	0
	LH1795	1	49	57	8	0	0
	LH1830	1	49	59	10	0	0
	Max	1	60	70	21	1	0
	Min	1	49	56	-4	0	0
	Total	6				1	0
GH North (Stations 1856 to 4105)	LH3830	1	49	63	14	0	0
	LH3840	1	49	57	8	0	0
	LH3875	1	49	57	8	0	0
	LH3975 (R15)	1	60	68	8	1	0
	LH3975A	1	60	62	2	0	0
	LH3980	1	60	63	3	0	0
	LH4030	1	60	64	4	0	0
	Max	1	60	68	14	1	0
	Min	1	49	57	2	0	0
	Total	7				1	0
GH South (Stations 1856 to 170)	LH3830	3	49	63	14	0	0
	LH3840	1	49	57	8	0	0
	LH42 (R15)	3	60	59	-1	0	0
	LH50	1	60	57	-3	0	0
	SR08	2	60	60	0	0	0
	SR13	10	60	60	0	0	0
	SR100	2	60	60	0	0	0
	Max	10	60	63	14	0	0
	Min	1	49	57	-3	0	0
	Total	22				0	0
HJ (Stations 4105 to 4948)	LH4110	1	57	60	3	0	0
	LH4155	1	57	58	1	0	0
	LH4165	1	49	67	18	1	0
	LH4530 (R16)	1	44	66	22	1	0
	LH4555	1	44	65	21	0	1

Source: The Louis Berger Group, Inc., 2002.

Table 4-36 (Cont.) U.S. Route 20 Noise Levels and Impacts along Sections Analyzed

Sections	Modeling Receptor ID	Number of Receptors	Existing Base Year Leq (dBA)	Year 2020 Leq (dBA)	Increase over Existing (dBA)	Receptor Meets NAC	Receptor with more than 14 dBA Increases
	LH4585	1	44	60	16	0	1
	LH4665	1	44	60	16	0	1
	LH4690	1	49	59	10	0	0
	LH4735	1	49	65	16	0	1
	LH4755	1	49	61	12	0	0
	LH4760	1	49	64	15	0	1
	LH4773	1	49	67	18	1	0
	LH4780	1	49	60	11	0	0
	LH4800 (R17)	1	49	62	13	0	0
	LH4845	1	49	66	17	1	0
	LH4850	1	49	66	17	1	0
	LH4910	2	49	64	15	0	2
	LH4910A	1	49	66	17	1	0
	LH4925	1	49	69	20	1	0
	Max	2	57	69	22	1	2
	Min	1	44	58	1	0	0
	Total	20				7	7
IJ (Stations 1831 to 1927)	EX1850	1	61	61	0	0	0
	EX1866	1	61	66	5	1	0
	LH4910	1	49	63	14	0	0
	LH4910A	1	49	68	19	1	0
	Max	1	61	68	19	1	0
	Min	1	49	61	0	0	0
	Total	4				2	0
IK (Stations 1831 to 2187)	EX1850	1	61	61	0	0	0
	EX1866	1	60	61	1	0	0
	EX1890	1	61	65	4	0	0
	EX1910	1	56	65	9	0	0
	EX1930	1	56	63	7	0	0
	EX1935	1	58	66	8	1	0
	EX1940	1	56	63	7	0	0
	EX1955	2	64	64	0	0	0
	EX1960	3	56	61	5	0	0
	EX1978	4	56	59	3	0	0
	EX1982	2	62	64	2	0	0
	EX1985 (R7)	2	64	62	-2	0	0
	EX2000	16	68	62	-6	0	0
	EX2015	1	56	67	11	1	0
	EX2035	1	66	68	2	1	0
	EX2040	1	56	65	9	0	0
	EX2041	1	56	69	13	1	0
	EX2052	1	65	69	4	1	0
	EX2075	1	65	67	2	1	0
	EX2090	1	64	69	5	1	0

Source: The Louis Berger Group, Inc., 2002.

Table 4-36 (Cont.) U.S. Route 20 Noise Levels and Impacts along Sections Analyzed

Sections	Modeling Receptor ID	Number of Receptors	Existing Base Year Leq (dBA)	Year 2020 Leq (dBA)	Increase over Existing (dBA)	Receptor Meets NAC	Receptor with more than 14 dBA Increases
	EX2105	1	58	62	4	0	0
	EX2105A	1	56	67	11	1	0
	EX2105B	2	56	60	4	0	0
	EX2125 (R8)	1	66	60	-6	0	0
	EX2145	1	66	63	-3	0	0
	EX2155 (R19)	2	58	63	5	0	0
	Max	16	68	69	13	1	0
	Min	1	56	59	-6	0	0
	Total	50				8	0
JK (Stations 4948 to 5179)	LH5010	1	49	65	16	0	1
	LH5030 (R18)	2	55	66	11	2	0
	LH5070	1	49	62	13	0	0
	LH5095	1	49	75	26	1	0
	LH5135	1	66	67	1	1	0
	LH5145 (R19)	1	58	67	9	1	0
	Max	2	66	75	26	2	1
	Min	1	49	62	1	0	0
	Total	7				5	1

Source: The Louis Berger Group, Inc., 2002.

U.S. Route 20 traffic would experience similar or worse LOS conditions in future year 2020 when compared to the LOS conditions in the existing year 2000, if no improvements are made. Therefore, traffic noise levels along U.S. Route 20 would not be expected to change substantially during the same period. As a result, noise levels were not modeled for the No-Action Alternative for the future year 2020.

4.5.2.2 Build Alternates

Future Build Year noise levels at the sensitive receptors located adjacent to the alternate sections are presented in Table 4-36 and are summarized below. The locations of the receptors for the various sections of the alternates are depicted on the Environmental Inventory Maps in Appendix N, and in Volume 2 of the Noise Technical Study. For each of the alternates, future Year 2020 noise levels were modeled using the FHWA STAMINA 2.0 program model. The results of the noise level modeling are presented in detail as follows:

- **Section AB**

Twenty-two receptors were identified along Section AB. The receptors are mostly single-family residences within the established farmsteads scattered on both sides of the alternates. Existing noise levels at these receptor locations ranged between 49 and 64 dBA, measured at representative sites R9 and R10 as well as calculated using the existing traffic data as provided. Year 2020 Build noise levels would range between 57 and 68 dBA. The Build Year noise levels would exceed the FHWA Noise Abatement Criteria of 67 dBA at three receptor locations. In addition, the Build Year 2020 noise levels would increase more than 14 dBA from existing noise levels and would exceed the Department's substantial increase criteria at two receptor locations. A total of five receptors would be considered as impacted along this section, based on the FHWA and the Department's criteria.

- **Section BC**

Nine receptors were identified along Section BC. These receptors are single-family residences within the established farmsteads scattered on both sides of the proposed Alternates. Existing noise levels at these receptor locations were 49 dBA, as measured at nearby representative site R9 along nearby Section AB. Noise receptors along this segment are considered equivalent to the noise measurement sites R9 in site geometry and traffic condition during the existing year. Year 2020 Build noise levels would range between 52 and 63 dBA. The Build noise levels would not exceed the FHWA Noise Abatement Criterion of 67 dBA at any receptor location. Furthermore, the Build Year noise level would not increase more than 14 dBA from the existing noise level, thus not exceeding the Department's substantial increase criteria. Based on the FHWA and the Department's criteria, therefore, no receptor would be considered as being impacted along this section.

- **Section BD**

Fourteen receptors were identified along Section BD. These receptors are mostly single-family residences within the established farmsteads scattered on both sides of the alternates. Existing noise levels at these receptor locations were 40 or 43 dBA, as measured at representative sites R20 and R21. Year 2020 Build noise levels would range between 56 and 68 dBA. The Build Year noise levels would exceed the FHWA Noise Abatement Criterion of 67 dBA at two receptor locations. The Build Year noise levels would increase more than 14 dBA from existing noise levels and would exceed the Department's substantial increase criteria at ten receptor locations. Based on the FHWA and the Department's criteria a total of 12 receptors would be considered as impacted along this section.

- **Section BF**

Eleven receptors were identified along Section BF. These receptors are mostly single-family residences within the established farmsteads scattered on both sides of the alternates. Existing noise levels at these receptor locations ranged between 48 and 56 dBA, measured at representative sites R11, R12, R13, and R14 as well as calculated using the existing traffic data as provided. Year 2020 Build noise levels would range between 58 and 70 dBA. The Build Year noise levels would exceed the FHWA Noise Abatement Criterion of 67 dBA at two receptor locations. The Build Year noise level would increase more than 14 dBA from existing noise levels and would exceed the Department's substantial increase criteria at one receptor location. Based on the FHWA and the Department's criteria a total of three receptors would be considered as impacted along this section.

- **Section CD**

Three receptors were identified along Section CD. These receptors are single-family residences within the established farmsteads on both sides of the alternates. Existing noise levels at these receptor locations ranged between 40 and 43 dBA, as measured at nearby representative sites R20 and R21. Year 2020 Build noise levels would range between 62 and 67 dBA. The Build Year noise level would exceed the FHWA Noise Abatement Criterion of 67 dBA at one receptor location. The Build Year noise levels would increase more than 14 dBA from existing noise levels and would exceed the Department's substantial increase criteria at two receptor locations. Based on the FHWA and the Department's criteria, all three receptors would be considered as impacted along this section,

- **Section CI**

One hundred and sixty-three receptors were identified along Section CI. These receptors are mostly single-family residences within the established farmsteads and subdivisions on both sides of the alternates. Existing noise levels at these receptor locations ranged between 40 and 74 dBA, based on measured and calculated results. Year 2020 Build noise levels would range between 52 and 70 dBA. The Build noise levels would approach or exceed the FHWA Noise Abatement Criterion of 67 dBA at 22 receptor locations. The Build Year noise levels would increase more than 14 dBA from existing noise levels and would exceed the Department's substantial increase criteria at four receptor locations. Based on the FHWA and the Department's criteria, a total of 26 receptors would be considered as impacted along this section.

- **Section DE**

Ten receptors were identified along Section DE. These receptors are mostly single-family residences within the established farmsteads scattered on both sides of the alternates. Existing noise levels at these receptor locations were 43 dBA, as measured at representative site R22. Year 2020 Build noise levels would range between 58 and 67 dBA. The Build Year noise levels would approach or exceed the FHWA Noise Abatement Criterion of 67 dBA at four receptor locations. The Build Year noise levels would increase more than 14 dBA from existing noise levels and would exceed the Department's substantial increase criteria at six receptor locations. Based on the FHWA and the Departments criteria, all ten receptors would be considered as impacted along this section.

- **Section EF – North**

Twenty-nine receptors were identified along Section EF-North. These receptors are single-family residences within the established farmsteads and subdivisions on both sides of the alternates. Existing noise levels at these receptor locations ranged between 46 and 63 dBA, based on measured and calculated results. Year 2020 Build noise levels would range between 52 and 68 dBA. The Build Year noise levels would exceed the FHWA Noise Abatement Criterion of 67 dBA at three receptor locations. The Build Year noise level would increase more than 14 dBA from existing noise levels and would exceed the Department's substantial increase criteria at one receptor location. Based on the FHWA and the Department's criteria a total of four receptors would be considered as impacted along this section.

- **Section EF – South**

Thirty-one receptors were identified along Section EF-South. These receptors are single-family residences within the established farmsteads and subdivisions on both sides of the alternates. Existing noise levels at these receptor locations ranged between 43 and 56 dBA, as measured at representative sites R14 and R23 and calculated at other locations using existing site geometry and traffic information. Year 2020 Build noise levels would range between 56 and 70 dBA. The Build Year noise levels would exceed the FHWA Noise Abatement Criterion of 67 dBA at two receptor locations. The Build Year noise levels would increase more than 14 dBA from existing noise levels and exceed the Department's substantial increase criteria at 14 receptor locations. Based on FHWA and the Department's criteria a total of 16 receptors would be considered as impacted along this section.

- **Section FG**

Six receptors were identified along Section FG. These receptors are mostly single-family residences within the established farmsteads scattered on both sides of the alternates. Existing noise levels at these receptor locations ranged between 49 and 60 dBA, based on the noise levels measured at sites R12 and R15 along nearby segments BF and GH North. Noise receptors along this segment are considered equivalent to the noise measurement sites R12 and R15 in site geometry and traffic condition during the existing year. Year 2020 Build noise levels would range between 56 and 70 dBA. The Build Year noise levels would exceed the FHWA Noise Abatement Criterion of 67 dBA at one receptor location.

- **Section GH – North**

Seven receptors were identified along Section GH-North. These receptors are mostly single-family residences within the established farmsteads scattered on both sides of the alternates. Existing noise levels at these receptor locations were 49 or 60 dBA, as measured at representative sites R12 and R15. Year 2020 Build noise levels would range between 57 and 68 dBA. The Build Year 2020 noise levels would exceed the FHWA Noise Abatement Criterion of 67 dBA at one receptor location.

- **Section GH – South**

Twenty-three receptors were identified along Section GH-South. These receptors are single-family residences within the established farmsteads and subdivisions on both sides of the alternates and Illinois Route 78. Existing noise levels at these receptor locations were 49 or 60 dBA, as measured at representative site R15 and other sites. Year 2020 Build noise levels would range between 57 and 66 dBA. The Build Year noise levels would not exceed the FHWA Noise Abatement Criterion of 67 dBA at any receptor location. The Build Year noise levels would not increase more than 14 dBA from the existing noise levels at any receptor location along this section.

- **Section HJ**

Twenty receptors were identified along Section HJ. These receptors are mostly single-family residences within the established farmsteads scattered on both sides of the alternates. Existing noise levels at these receptor locations ranged between 44 and 57 dBA, as measured at representative sites R16 and R17 and calculated at other locations using existing site geometry and traffic information. Year 2020 Build noise levels would range between 58 and 69 dBA. The Build Year noise levels would exceed the FHWA Noise Abatement Criterion of 67 dBA at seven receptor locations. The Build Year noise levels would increase more than 14 dBA from existing noise levels and would exceed the Department's substantial increase criteria at seven receptor locations. Based on the FHWA and Department's criteria a total of 14 receptors would be considered as impacted along this section.

- **Section IJ**

Four receptors were identified along Section IJ. The receptors are single-family residences within the established farmsteads scattered on both sides of the alternates. Existing noise levels at these receptor locations ranged between 49 and 61 dBA, based on the measured alternates and calculated noise level results. Year 2020 Build noise levels would range between 61 and 68 dBA. The Build Year noise levels would approach or exceed the FHWA Noise Abatement Criterion of 67 dBA at two receptor locations. Based on the FHWA and the Department's criteria, a total of two receptors would be considered as impacted along this section.

- **Section IK**

Fifty receptors were identified along Section IK. These receptors are mostly single-family residences within the established farmsteads and subdivisions on both sides of the alternates. Existing noise levels at these receptor locations ranged between 56 and 68 dBA, based on measured and calculated noise level results. Year 2020 Build noise levels would range between 59 and 69 dBA. As a result, the Build Year noise levels would approach or exceed the FHWA Noise Abatement Criterion of 67 dBA at eight receptor locations.

- **Section JK**

Seven receptors were identified along Section JK. These receptors are mostly single-family residences within the established farmsteads scattered on both sides of the alternates. Existing noise levels at these receptor locations ranged between 49 and 66 dBA, as measured at representative sites R17, R18, and R19 and calculated with provided traffic and topographic information at one receptor location. Year 2020 Build noise levels would range between 62 and 75 dBA. The Build Year noise levels would exceed the FHWA Noise Abatement Criterion of 67 dBA at five receptor locations. The Build Year noise level would increase more than 14 dBA from existing noise levels and would exceed the Department's substantial increase criteria at one receptor location. Based on the FHWA and the Department's criteria a total of six receptors would be considered as impacted along this section.

4.5.3 Mitigation

Mitigation of noise levels may occur at the noise source, along the path of the noise, or at receiver locations. Mitigation of noise levels occurs in nature to varying degrees as sound propagates from the source over terrain surfaces (scattering and ground attenuation), as the distance between the source and receiver increases (dispersion), and when intervening natural terrain features intersect the path of the noise source to the receiver (diffraction).

Within practical limits, these same principles would be applied to the mitigation of noise levels from traffic operations. Mitigation of the noise source is achieved by regulatory limits on vehicle emissions by mufflers and exhaust systems. A variety of mitigation measures, as specified in 23 CFR Part 772, can also be considered either at the roadway, along the path of the noise, or, in limited situations, at the receiver. These measures include:

- traffic management measures that alter vehicle type, speed, volume, and/or time of operations,
- Highway alignment alterations, such as shifting the roadway away from sensitive receptors or depressing the roadway into the ground,
- Acquisition of real property or interest therein to serve as a buffer zone,
- Noise insulation of public buildings.

The most common type of designed mitigation is the construction of physical barriers, typically in the form of noise walls (noise barriers) and/or earth berms between the roadway (noise source) and the receiver locations. According to the Department's *Procedures for Highway Project Noise Analyses*, a minimum of 8-dBA reduction in highway traffic noise levels is required to protect the receptor(s). Mitigation is designed to achieve these levels of noise reduction rather than a specified absolute noise level. Therefore, mitigation may be appropriate even if the mitigated noise level exceeds FHWA's NAC for a particular activity category. For the proposed project, barrier costs were estimated using a factor of $278 per square meter ($25.00 per square foot) of barrier panel. Any receptors that received a five dBA or more of noise level reduction would be considered as having benefited from the construction of such a barrier. A barrier is considered reasonable by the Department if it costs less than $24,000 per benefited residence.

For the majority of the areas along the alternates, the noise receptors identified as impacted are scattered too far apart to permit noise barriers to be built at a reasonable cost. Therefore, noise barriers were not studied for areas, communities, and subdivisions with less than six sensitive receptors. Only two residential subdivisions include groups of six or more sensitive receptors identified as being impacted by the proposed alternates. Noise barriers were analyzed for these residential subdivisions along alternate sections CI and EF-South, respectively.

Preliminary noise barrier locations with uniform heights between 4.3 and 9.2 meters (14 and 26 feet) were modeled and evaluated for two groups of impacted receptors along the proposed alternates. The number of single- and multiple-family residences and other receptors receiving various levels of noise reduction benefits (i.e., 3, and 8 or more dBA reductions) as the result of the noise barriers analyzed were counted for each receptor group. The number of benefited residences, as defined in Department's noise policy was then used to evaluate the reasonableness of each noise barrier height analyzed.

The range of noise level reductions and number of benefited receptors associated with each of the uniform barrier heights analyzed (i.e., 14, 16, 18, 20, 22, 24, and 26 feet) at each barrier location are presented in Table 4-37. As can be seen from that table, the amount of noise level reduction and number of benefited receptors generally increase when the height of the barrier increases. Noise level reductions range from 2 to 9 dBA at individual receptors within the groups studied. Preliminary noise barrier locations are presented in Figures IV-46, IV-71 and IV-72 in Volume 2 of the Noise Technical Study.

Barrier 1 at Galena Ridge Subdivision (along Section CI)

The area behind the proposed barrier consists of single-family residences in the Galena Ridge subdivision adjacent to the westbound lanes of Alternate Section CI, west of South Evans Road.

Future Build noise levels without the construction of a noise barrier would range from 57 to 66 dBA at 19 single-family residences in the area. Future Build noise levels would be reduced between five and six dBA as the result of a noise barrier extending 841 meters (2,760 feet) in length and 6.1 meters (20 feet) in height. Abated noise levels at these receptors would range from 52 to 60 dBA, depending on the location of the receptor. With the proposed noise barrier, no residence would receive more than a six dBA noise level reduction. Also increasing in the height of the barrier would not result in any increase in noise level reduction because of the roadway entry opening in the middle of the area. Therefore, a noise barrier at this location is not considered reasonable and feasible.

Barrier 2 at Galena Oaks Subdivision (along Section EF-South)

The area behind the proposed barrier consists of single-family residences in the Galena Oaks subdivision adjacent to the westbound lanes of the Alternate Section EF-South, between Read and East Center Roads.

TABLE 4-37
U.S. ROUTE 20 (FAP 301)
GALENA TO FREEPORT
JO DAVIESS AND STEPHENSON COUNTIES
NOISE ANALYSIS

Noise Level Reductions (in dBA), Length, Heights, and Costs of the Evaluated Noise Barriers

	Receptor ID	Number of Residences	Without Barrier	Barrier Heights in Feet													
				14		16		18		20		22		24		26	
			NL	NL	NR	NL	NR	NL	NR	NL	NR	NL	NR	NL	NR	NL	NR
Barrier 1 Section CI	EX995	6	66	62	4	61	5	61	5	60	6	60	6	60	6	60	6
	EX995A	12	57	54	3	53	4	53	4	52	5	22	5	52	5	52	5
	Barrier Length in Feet			2760		2760		2760		2760		2760		2760		2760	
	Total Barrier Cost			$966,000		$1,104,000		$1,242,000		$1,380,000		$1,518,000		$1,656,000		$1,794,000	
	Minimum of 8 dBA reduction?			No		No		No		No		No		No		No	
	Number of Benefited Residences			0		6		6		18		18		18		18	
	Cost per Benefited Residence			N/A		$184,000		$207,000		$76,667		$84,333		$92,000		$99,667	

	Receptor ID	Number of Residences	Without Barrier	Barrier Heights in Feet													
				14		16		18		20		22		24		26	
			NL	NL	NR	NL	NR	NL	NR	NL	NR	NL	NR	NL	NR	NL	NR
Barrier 2 Section EF South	IH6713	3	64	60	4	59	5	58	6	57	7	56	8	56	8	55	9
	IH6714	7	61	58	3	57	4	57	4	56	5	55	6	54	7	54	7
	IH6715	9	59	57	2	56	3	56	3	55	4	54	5	54	5	53	6
	Barrier Length in Feet			2690		2690		2690		2690		2690		2690		2690	
	Total Barrier Cost			$941,500		$1,076,000		$1,210,500		$1,345,000		$1,479,500		$1,614,000		$1,748,500	
	Minimum of 8 dBA reduction?			No		No		No		No		Yes		Yes		Yes	
	Number of Benefited Residences			0		3		3		10		19		19		19	
	Cost per Benefited Residence			N/A		$358,667		$403,500		$134,500		$77,868		$84,947		$92,026	

(1) NL is the noise level in dBA with or without the proposed noise barriers.
(2) NR is the noise level reduction in dBA associated with the proposed noise barriers.
(3) The cost is calculated based on a factor of $25.00 per square foot of the barrier surface.
(4) The residences with noise reduction of 5 dBA or more are considered as benefited.

Future Build noise levels without the construction of a noise barrier would range from 59 to 64 dBA at 19 single-family residences. Future Build noise levels would be reduced by between five and eight dBA as the result of a noise barrier extending 820 meters (2,690 feet) in length and 6.7 meters (22 feet) in height. Abated noise levels at these receptors would range from 54 to 56 dBA, depending on the location of the receptor. With the proposed noise barrier, the three first-row single-family residences would receive an eight dBA noise level reduction while the remaining 16 residences would receive between a five and a seven dBA noise level reduction. A noise barrier at the location would cost approximately $1,479,500 or $77,868 per benefited residence, which exceeds the Department's reasonableness criterion of $24,000 per benefited residence. Although increasing the height of the barrier would result in a slight increase in noise level reduction, it would have resulted in a substantial increase in total cost as well as cost per residence. Barrier heights of less than 20 feet would result in a seven dBA or less noise level reduction at the first-row receptor locations, which is not considered acceptable per policy. Therefore, a noise barrier at this location is not considered reasonable or feasible.

4.5.4 Construction Noise

Construction noise differs from traffic noise in the length, type and duration of noise events. Construction noise is of a fixed duration and ceases at the completion of the construction phase. Construction noise, usually limited to daylight hours, differs from normal vehicular traffic noise, which continues throughout the day- and nighttime hours. Additionally, construction-related noise is responsible for a variety of impulsive, discontinuous noise sources, such as jack-hammers and/or vibratory rollers. Traffic noise, although varying in level, is more continuous as a noise source. A temporary increase in noise levels will occur during the time period that construction takes place. Noise levels due to construction, although temporary, can impact areas adjacent to the proposed project.

Impacts due to construction noise are dependent upon the following criteria:

- Time and duration of construction activities
- Equipment types
- Equipment usage cycle.

Typical construction phases for the proposed project may involve the following construction activities:

- **Demolition:** Removal of structures within the right of way.
- **Clearing and Grubbing:** Existing landscaping, along with unwanted earth and rock.
- **General Earthwork:** Site topography will be altered in order to prepare the area for the roadway design. Earth moving operations will be required to prepare the roadbed. Trenches will be excavated for drainage materials.
- **Foundations:** Preparation for and construction of foundation support systems for both bridge and other primary foundation structures.
- **Paving Operations:** Preparation of the base layer, such as roadbed compaction and the laying of substrata material as well as surface paving operations.

- **Finishing:** Cleanup and landscaping.

Equipment such as bulldozers, scrapers, pavers, backhoes, graders, loaders, cranes, trucks, compressors, vibratory compactors, generators, and pile driving operations are typically utilized during construction.

Construction noise will be controlled in accordance with Article 107.35 of the *Standard Specifications for Road and Bridge Construction* as adopted January 1, 2002. In addition, the following mitigation strategies will be employed to the greatest extent possible to limit the potential impact of noise during construction:

- Source Control
  - All exhaust systems in good working order, also using properly designed engine enclosures, and intake silencers.
  - Regular equipment maintenance.
- Site Control
  - Placement of stationary equipment as far away from residential receptors as possible (i.e., pumps, compressors, aggregate crushers, AC plants, operators, etc.).
  - Choice of disposal sites and haul routes thereto.
  - Employing shielding where possible.
- Time and Activity Constraints
  - Schedule of operations to coincide with periods when people would least likely be affected.
  - Limiting working hours and work days to least noise sensitive times.
- Community Awareness
  - Public notification of construction operations.
  - Methods to handle complaints.

4.6 Natural Resources

4.6.1 Geology

The proposed project has the potential to impact geological resources. In addition, surface conditions (soils and geology) and bedrock geology along the proposed alignments place constraints on construction practices and project design. The impacts and constraints of the geologic setting of the alternates are discussed below.

4.6.1.1 Bedrock and Structural Geology

The location, depth of occurrence, and geotechnical properties of soil and geologic units (surficial and bedrock) in the project area are provided in the IDOT Preliminary Geotechnical Engineering Report (September 1998) and the IDOT Geotechnical Engineering Report (January 1999) for a Terrapin Ridge tunnel (proposed in Alternates 5, 6, 8, 10). A geotechnical report prepared by the Illinois Division of Highways (Brownfield 1968) was referred to in both project geotechnical reports. Brownfield (1968) evaluates the subgrade and bearing performance of units expected to be encountered. Dolomite bedrock is permeable and will provide, with a granular subbase, very good subgrades. Shale bedrock is impervious. If drained and overlain with a granular subbase, shale bedrock will provide a satisfactory subgrade. As foundations for structures, the Galena dolomite performs well. Due to the prevalence for Silurian dolomites to slide, any foundations in this unit will be located a sufficient distance from natural cliffs or benched road cuts. Shale bedrock is good bearing if drained and will support a lined tunnel.

During earlier widening of U.S. Route 20 down the hill from the Longhollow Observation Tower toward Elizabeth, joints and fractures in the Silurian dolomite were opened by blasting (Reinertsen and Frankie, 1994). Rock excavation by blasting could produce new joints and fractures in bedrock as well as cause damage to human-made structures. Blasting operations, if necessary, will be controlled to prevent vibration impacts.

4.6.1.2 Surface Geology and Topography

Brownfield (1968) evaluates the subgrade and bearing performance of units expected to be encountered by the alternates. Well-drained loess will provide a fair subgrade. Poorly drained loess will provide a poor subgrade. The performance of streamside and terrace soils as subgrade will vary with drainage. A well-drained soil will have good to fair performance while poorly drained soils will perform poorly. Streamside and terrace soils will require pilings at wide stream crossings. The technical stability and settlement constraints posed by surficial soils will be overcome through appropriate design and construction techniques.

Horseshoe Mound is an Illinois Natural Area (geological feature). The proposed Horseshoe Mound Interchange of Section A-B for each alternate lies east of Horseshoe Mound. Proposed interchange approach ramps will abut its base. Horseshoe Mound will not be crossed and thus, will not be impacted.

The topographic relief along the project alignments ranges from about 122 meters (400 feet) on the rolling hills of the Till Plains Section (Stockton to Freeport) to about 183 meters (600 feet) on the stream dissected plateau of the Driftless Section (Galena to Stockton). The rapidly changing relief of the Driftless Section landscape imposes unique constraints on the engineering design of the roadway and construction practices that will be incorporated in the final design of the roadway.

Highly erodible soils are defined as soil series phases with slope designations of C or higher (4 percent or steeper slopes) (see Table 2-15). Approximately 9,238 hectares (22,826 acres) of highly erodible lands occur within the project area. Areas of highly erodible lands are mainly confined to steeply sloping upland areas. The location of the roadway will be placed to minimize soil cuts and long-term maintenance issues including sloughing. Benching of the high cut and fill slopes is proposed where necessary to minimize soil erosion and long-term maintenance. Erosion control features will be designed during the Phase II design process in accordance with the *Standard Specifications for Road and Bridge Construction* (IDOT 2002).

4.6.1.3 Mineral Resources

None of the active gravel pits and quarries located within the project area will be impacted by the alternates. The nearest active quarries are the Eustice Quarry on U.S. Route 20 and the East Galena quarry on West Stagecoach Trail. These will not be impacted (see Exhibits). An abandoned quarry on West Stagecoach Trail will be impacted by Section A-B (Exhibits), which is common to all Alternates.

4.6.1.4 Caves and Sinkholes

In the Driftless Section, the proposed roadway will be susceptible to impacts from karst features present in underlying carbonate rocks. These impacts include instability from the increased loading on existing rock cavities or the removal of structurally sound overburden and rock cover over existing cavities (Fischer *et al.* 1993). Construction related changes in the water table can induce subsidence and undermine the highway (Mellett and Maccarillo 1993). In karst terrains, groundwater is very susceptible to contamination from stormwater runoff because of rapid recharge through open conduits. The infiltration of stormwater runoff can facilitate the development of collapse features. If Karst features are encountered during the design of the selected alternate, special design consideration will be applied to prevent groundwater contamination. Stormwater runoff drainage designs will minimize infiltration and convey runoff to discharge points outside the vulnerable area, as necessary.

4.6.1.5 Land Subsidence and Landslides

In the areas surrounding Galena and Elizabeth, the alternates traverse areas with abandoned mines. Areas close to underground mines may be susceptible to subsidence (Bauer *et al.* 1993). Subsidence induced by loading stress in the vicinity of an abandoned mine is a potential problem (personal communication, April 1998, Illinois Department of Natural Resources). According to IDNR, subsidence problems would be a matter of type and depth of mining. The locations of known abandoned mines near the alternates are provided in Exhibits. Mines located within approximately 152 meters (500 feet) of the R.O.W. are: Mines 2, 6, 7, 9, 12, 37 (Section A-B); Mines 13, 14, 16 (Section B-F); Mines 18, 21, 42 (Sections D-E and C-I). Subsidence related to these mines will be overcome through appropriate design and construction techniques.

As described in the Affected Environment section, various surficial geological conditions exist throughout the project area that is prone to slumping and landsliding. Stability will be considered in road design. Units of particular concern are Silurian dolomites, weathered Maquoketa shale, and soils with low cohesive strength. The geotechnical engineering reports prepared for the proposed project have identified potential impacts and constraints imposed by the geotechnical properties of the surface and subsurface material anticipated to be encountered during construction. Of particular concern are slope stability and the presence of water. The stability of cut slopes will depend on the type of material, presence of seepage water, and depth of cut. Conditions identified in the geotechnical reports as vulnerable to slope instability include rock excavations where Silurian dolomites are underlain with Maquoketa shale; embankment fills; and the presence of subsurface water. Rock slopes can be stabilized by reinforcing the unstable cut slopes with retaining walls; cement grouting of fissured, cracked and creviced rocks; placing wire mesh on excavated and natural rock slopes to prevent the falling of rocks; and placing gabion baskets combined with wire mesh to protect slope faces. Rock-bolting and anchoring can reinforce the unstable cut slope to prevent blocks from falling. Subsurface drainage will be needed in areas where groundwater is shallow or expected to intersect cut slope surfaces. When subsurface embankment is saturated, embankment failure is possible. Water can be prevented from saturating pavement subgrades by installing drains to divert surface runoff or by removing water in subgrades with underdrains or drainage blankets. Dewatering plans will be implemented during tunnel construction.

4.6.1.6 Groundwater Resources

Potential impacts to groundwater resources from the proposed project include encroachment into Wellhead Protection Areas and setback zones; loss of aquifer recharge area; and impacts to groundwater quality by contaminants associated with project related construction period and post-construction activities.

An inventory of wells located near each alternate was conducted in 2001 (ISGS2001). Although 26 of the 171 wells identified by ISGS are within 200 feet of the centerline of the alternates, the 200-foot wellhead setback is only relevant for routes or sources of groundwater pollution. Since the project will not introduce any new routes (dry wells or borrow pits) or sources (bulk road oil or deicing salt storage facilities), there will be no violation of the wellhead setback requirements. Operational facilities located along the roadway within the setback zone can be allowed by permit. Any wells encountered during construction will be properly sealed.

Aquifers in the project area recharge by the infiltration of precipitation. The probability of precipitation infiltrating the soil surface and percolating downward to the uppermost aquifer has been mapped by Keefer and Berg (1990) as the potential for aquifer recharge. A close assessment of this map indicates that, in Jo Daviess County, the areas of relatively higher aquifer recharge potential are associated with streams and areas bordering streams. A comparison of the aquifer recharge area with the potential for shallow aquifer contamination indicates that these areas consist of stream alluvium deposits and permeable bedrock between 1.5 and 6.1 meters (5 and 20 feet) of the surface which is overlain by silty or clayey overburden and contains a relatively impermeable weathered zone. Due to the presence of a relatively impermeable weathered zone, stream alluvial deposits would be the areas most vulnerable to impacts from the loss of recharge area.

Portions of these areas will be crossed on structure. There will be no loss to aquifer recharge area where the new road is on structure. Where the roadway is not on structure, the runoff from the new paved roadway surface will not be lost to the groundwater system but will be contained within it by being directed to grassed medians and roadside drainage ditches or local streams. Drainage ditches and embankment slopes after construction will be vegetated and non-paved, and thus will continue to facilitate recharge. Similarly, in Stephenson County, the areas of relatively higher aquifer recharge potential are associated with alluvium of the Yellow Creek and Pecatonica systems. The runoff associated with Yellow Creek and Pecatonica River tributary crossings, where not bridged, will not be lost to the groundwater system but will be directed to it by conveyance to grassed medians, roadside drainage ditches, or local streams.

The replacement of pervious ground surfaces with impervious roadway surfaces will result in the loss of aquifer recharge area. However, the impacts to the aquifer system of the project area will be small and not be adverse.

4.6.1.7 Groundwater Quality

During construction, project related sources of contamination (e.g., disturbed contaminated sediments and groundwater) might exist. Accidental spills and temporary staging areas for construction equipment and supplies are also potential contaminant sources. When the roadway is operational, potential post-construction sources of contaminants are highway stormwater runoff, snowmelt from roadside snowbanks, and accidental spills. Unconfined sand and gravel aquifers and shallow, highly fractured bedrock aquifers are most vulnerable to water quality impacts, particularly in karst areas.

Conditions most favorable for rapid downward movement to shallow aquifers in Illinois are: 1) permeable bedrock within 1.5 meters (5 feet) of the surface; 2) permeable sand and gravel greater than 6.1 meters (20 feet) thick directly below the land surface; and 3) thick, permeable sand and gravel overlain by silt at least 1.5 meters (5 feet) thick (Berg *et al.* 1984). These conditions are not present in the project area. Thus, adverse impacts to groundwater quality

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